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(54) AN AUTOMATIC LOADING APPARATUS

(71) We, BERNHARD BEUMER MASCHINENFABRIK KG, a German company, of 4720 Beckum, Oelder Strasse 40, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

The present invention relates to an automatic loading apparatus for loading discrete cargo such as sacks onto stationary or mobile loading platforms. For loading stationary and mobile loading surfaces such as loading platforms of trucks, railroad carriages, containers, ships, pallets or the like with sacks, there are already known sack loading plants including a movable carrier conveyor system that may be advanced into the loading area so that the discharge point may be brought into any desired position of the loading area. The head portion of a carrier conveyor system of this type includes a two-member loading assembly adapted to be moved through the three dimensions in space so that the assembly may be telescopically extended or retracted or moved through predetermined angular ranges in horizontal and vertical directions. A drawback of heretofore known loading apparatus of this type is that several operators are required for stacking the sacks which stacking has still to be performed manually.

One type of a heretofore known loading apparatus includes a packing plate to which the discrete goods are supplied, along a roller track. The free discharge end of the roller track may be adjusted vertically in order to adapt the elevation of the same to the elevational height of the packing plate. With this known apparatus, cardboard boxes are pushed off the packing plate by means of a pusher member extending parallel to the packing plate longitudinal direction. This type of pusher bar or pusher plate, however, does not allow sacks to be pushed off, since the contents of the sacks will be compressed by the advancing pusher member, with the result that no perfectly shaped sack stacks of a high inherent rigidity may be obtained. Additionally, in this prior art apparatus another transverse pusher member is arranged above the packing plate.

In another heretofore known loading apparatus the discrete goods are fed along a carrier conveyor toward a horizontal roller track, and a packing plate is arranged at the downstream end of the roller track. The packing plate extends transversely of the piece goods feed direction and may be elevationally adjusted together with the roller track. The discharge end of the carrier conveyor may be adjusted according to the height of roller track and packing plate. The transfer of a packing row is effected by means of a transfer bar, and concurrently the packing plate is withdrawn from below the sack layer, in order to transfer the sack layer being held between a front abutment surface and a rear abutment.

It is the main object of the present invention to provide a novel and improved automatic loading apparatus for discrete goods, and which is particularly suitable for use with sacks.

It is another object of the present invention to provide an automatic loading apparatus that allows an efficient automatic stacking of discrete goods onto loading surfaces, at a relatively high rate, and without requiring the heretofore necessary operators.

In accordance with the present invention, apparatus for loading discrete goods onto loading platforms comprises a support and a loading head depending from and vertically movable in the support, the loading head including:

a rectangular horizontal frame,

a packing table defining a goods-receiving

surface and movable in the frame in a first direction between a rest position and a pull-off position,

conveyor means arranged to feed discrete goods one by one to a predetermined point on the packing table in its rest position,

a first stop member mounted on the frame and extending at substantially right angles to said first direction across the whole width of the packing table when the latter is in its rest position,

a pusher member arranged in a vertical plane aligned with said first direction, the pusher member having one end thereof adjacent the goods-receiving surface of the packing table in the rest position of the latter and being drivable in a second direction perpendicular to said first direction to either side alternately through a predetermined distance, and

a second stop member parallel to the first stop member and spaced therefrom, whereby on movement of the packing table from its rest position to its pull-off position goods on the packing table butt against the second stop member to be pulled off the packing table onto a loading surface beneath.

A loading apparatus in accordance with the invention when used to load sacks has the advantage that sack layer assembled on the packing table may be stacked onto an already formed sack layer without thereby shifting the sack contents, and thus allows sacks to be loaded in the form of sack stacks of an inherent rigidity. When the sacks are being fed onto the packing plate, the sacks engage the first stop member provided at one face of the packing plate so that the sack contents are compressed in the direction of the first stop member. Whilst the individual sacks are being laterally shifted by means of the transverse pusher member, the sack contents are not being compressed in the region abutting the transverse pusher but will be spread evenly throughout the shifting movement so that perfect sack layers may be obtained.

In the following, the invention will be described more in detail with reference to several preferred embodiments illustrated in the appended drawings wherein:—

Figure 1 is a schematical lateral elevational view of an automatic loading apparatus in accordance with the present invention, the apparatus including sack feeding means in the form of a chute;

Figure 2 is a schematical front elevational view of the loading apparatus shown in Figure 1;

Figure 3 is a lateral elevational view of another embodiment of the loading apparatus wherein the sack feeding means consists of a belt conveyor;

Figure 4 is a schematical front elevational view of the loading apparatus of Figure 3;

Figures 5–11 are lateral elevational views for illustrating the loading operation on the packing plate of the loading apparatus, showing the various phases of sack feeding;

Figure 12 is a schematical lateral elevational view of the loading head of the loading apparatus with a sack feeding track in the form of a chute;

Figure 13 is a front elevational view of the loading head of Figure 12;

Figure 14 is a lateral elevational view of the loading head of the loading apparatus and of a feed belt conveyor of a horizontally movable loading plant for loading the loading platform of motor vehicles;

Figure 15 is a front elevational view of the chute of Figure 14;

Figure 16 is a front elevational view of the loading head of the loading apparatus after the loading head has been shifted by a distance corresponding to half a sack width, and further illustrating schematically a truck with sacks stacked thereon whereby the uppermost sack layer is laterally displaced;

Figure 17 is a schematical illustration in a lateral elevation of the loading apparatus with sack feed track;

Figure 18 is a lateral cross-sectional view of the loading apparatus having a packing table surface in the form of a roller track;

Figure 19 is a cross-sectional view of the loading apparatus wherein the packing table surface consists of a roller track;

Figure 20 is a vertical sectional view of the loading track wherein the packing table surface consists of a belt conveyor;

Figure 21 is a cross-sectional view of the loading apparatus wherein the packing table surface consists of a belt conveyor; and

Figure 22 is a vertical sectional view of a packing table wherein the packing table surface consists of a roller track and further illustrating a pusher fork adapted to be moved by control levers.

Referring to Figures 1–4, the loading apparatus 10 is mounted at the discharge end of a feed belt conveyor and comprises a support assembly 11 formed by a vertical support column 12 and a horizontal support member 130 integral therewith and including an angle of substantially 90° with the support column 12. The free upper end of the support column 12 is mounted in a guide assembly indicated at 14 of a frame structure so that the support assembly 11 is vertically movable in the guide assembly in the direction of the double headed arrow x. A drive mechanism or unit 15 is provided for moving the support frame assembly 11 up and down in the guide assembly 14.

The horizontal support member 130 of the support assembly 11 forms a substantially rectangular cantilevered frame with side members 16, 17 and 18, as may best be

seen in Figure 2. The front side member 18 of the support member 13 mounts a vertical stop or abutment plate 19. The longitudinal side frame members 16, 17 define guide rails 20, 21 or alternatively are provided with exterior guide rails for guiding platelike carriages 22 and 23 respectively.

The carriages 22, 23 support a packing plate 25 and are adapted to be moved in a substantially horizontal direction, as indicated by the double headed arrow x_1 in Figure 1, by means of a common drive unit 26. The packing plate 25 may alternatively be supported directly in the frame members 16, 17, 18 of the support frame assembly 11 and be guided thereby in the above described manner. Thus, the frame side members 16, 17 may be provided with guide rollers such as guide rollers 24 shown in Figures 1 and 2. Correspondingly, the carriages 22, 23 mounting the packing plate 25 and movable along the sides of the frame are provided in their upper end regions with guide rails for the guide rollers 24.

The width of the packing plate 25 corresponds preferably to the length of a discrete cargo unit, i.e. in the present instance to the length of a sack S. The length of the packing plate 25, however, corresponds to a multiple of the width of a sack. In the embodiment shown in Figures 1 to 11, the packing plate 25 has suitable dimensions to receive five sacks S aligned in a row side by side. The length of the stop or abutment plate 19 corresponds substantially to the length of the packing plate 25, and the stop plate extends parallel to the packing plate 25.

A feed track for discrete cargo units such as sacks S is mounted in the support frame 11 above the packing plate 25. In the embodiment shown in Figures 1 and 2 the feed track consists of a chute 30 whereas in the embodiment shown in Figures 3 and 4 the feed track consists of a belt conveyor 40 comprising a driven continuous conveyor belt 41 passing over guide rollers of which only one guide roller 42 on the discharge side of the conveyor belt is shown. The feed track 30 or respectively 40 may also consist of a roller track (not shown) having driven rollers if the roller track extends substantially horizontally, or having idling rollers if the roller track is inclined with respect to a horizontal plane. The mutual arrangement of feed track 30 or 40 and packing plate 25 is selected so that sacks S supplied by the feed track 30 or the feed track 40 respectively will be put down on the packing plate 25 in front of the stop plate 19. The feed track 30 or the feed track 40 respectively is approximately centered with respect to the packing plate 25 and may be adjusted up and down, together with the support frame in the direction of the double headed arrow x, as shown in Figure 1.

A carriage 50 is movably supported on the front member 18 of the support frame 11. The carriage 50 is movable in a direction parallel to the longitudinal extension of the packing plate 25. The carriage 50 mounts upright platelike transverse pusher 51. The frame member 18 of the support frame 11 defines a guide rail along which the carriage 50 with the transverse pusher 51 may be moved in the direction of the double headed arrow x_2. A drive unit 53 consisting of a crank drive 54, 55 serves to move the transverse pusher 51 towards either end of the packing plate 25 by increments corresponding substantially to the width of a sack S. In Figure 2 the transverse pusher 51 is shown in both end positions, i.e. in the end position A in solid lines, and in the opposite end position B in broken lines. Instead of a crank drive 54, 55 it is considered to be within the scope of the present invention to employ any other type of drive unit for oscillating the transverse pusher 51.

To adapt the loading apparatus to any given position of a loading platform, the entire apparatus may be adjusted in a direction parallel to the longitudinal extension of the packing plate 25 in the direction of the double headed arrow x_3 of Figure 2 by means of a drive mechanism not shown in the drawings. For facilitating the positioning of the apparatus there may be provided radiation barriers or optical light switches that are disposed in suitable positions such as for example adjacent the free ends of the packing plate 25. As may be seen in Figure 4, the overall loading apparatus may also be movable in the direction of the double headed arrow y_4, i.e. transversely of the longitudinal extension of the loading platform.

The drive units 26, 23, 15 for moving respectively the packing plate, for alternately moving the transverse pusher 51 and for adjusting the elevation of the support frame assembly are controlled by a control unit 60 (Figure 1) which provides a certain timing sequence for the various movements of the individual components whereby the sacks S supplied onto the packing plate 25 are moved sideways over a distance corresponding substantially to the width of a sack, towards alternately the one or the other end of the packing plate 25, in thus forming a row of sacks SR on the packing plate 25. When a row of sacks SR has been formed on the packing plate 25, the latter is withdrawn towards the rear of the support frame 11 whereby the row of sacks SR is transferred onto a loading platform or onto the upper surface of one or several rows of sacks that may already have been arranged on a loading platform. Subsequently, the support frame 11 is lifting together with the packing plate 25 through a distance corresponding substantially to the height of a layer of sacks.

and the packing plate 25 simultaneously returns into its initial front position.

The operation of the automatic loading apparatus of the present invention is briefly as follows:

First of all, the loading apparatus is adjusted manually or assisted by optical light barriers or other suitable control devices into a suitable loading position, i.e. into a predetermined position with respect to a loading platform. The loading operation which may then be initiated is performed fully automatically. A first sack S1 is supplied by the chute 30 to the main components of the loading apparatus proper and is deposited onto the packing plate 25 in front of the stop plate 19. Then this sack S1 is moved by means of the transverse pusher 51 in a direction towards the end of the packing plate 25 indicated by 25a in Figure 5. The next following sack S2 supplied to the loading apparatus will be moved by a corresponding movement of the transverse pusher 51 in a direction towards the end 25b of the packing plate 25, as shown in Figure 6. The next sack S3 supplied is then pushed into the gap left between the sack S1 and S2 whereupon the transverse pusher 51 moves both sacks S3 and S1 towards the packing plate end 25a, as shown in Figure 7. The fourth sack S4 will come to rest in the gap between the sacks S2 and S3 whereupon the sack S4 together with the sack S2 will be moved by means of the transverse pusher 51 towards the packing plate end 25b, as may be seen in Figure 8. The transverse pusher 51 then occupies the position shown in Figure 9. The fifth sack S5 will then be pushed into the gap between the sack S3 and the sack S4 so that at this moment a row of sacks SR consisting of five sacks S1–S5 has been arranged on the packing plate 25, as may be seen in Figure 9.

As soon as a row of sacks SR has been lined up on the packing plate 25 in the above described manner, the packing plate 25 is withdrawn towards the rear of the loading apparatus, i.e. towards the vertical support column 12 (Figure 10), whereby the row of sacks SR consisting of the sacks S1–S5 will be transferred onto the loading platform. The loading apparatus is then lifted through a distance corresponding substantially to the height of this row of sacks SR, and the packing plate 25 is simultaneously returned into its initial front position. The loading cycle as shown and described with reference to Figures 5–11 may then be repeated.

Referring to Figures 12–16, the embodiment of the inventive loading apparatus shown therein includes a loading head 10 with an elevating frame 110 mounting the chute 30, the pusher beam 91, an adjustable stop plate 219 as well as spring plates 117, 118 and 315 (Figures 12 and 13). The elevating frame 110 serves to guide platelike slides 223, 222 that support the packing plate 25 and are adapted to be moved in the horizontal direction x_1 by a common drive unit 226. At one face of the elevating frame 110 is mounted a movable carriage 242. The carriage 242 extends parallel to the longitudinal direction of the packing plate 25 and may be moved into the direction of the arrow x_2. The carriage 242 mounts a vertical platelike transverse pusher 241.

The adjustable pusher beam 91 may likewise be moved parallel to the longitudinal direction. The stop 219 is adjustable in the horizontal direction as shown by x_4. By means of a drive unit 243 with a crank drive 244 the transverse pusher 241 may be moved towards both ends of the packing plate 25 by the width of a sack into the stop positions A and B. The loading head 10 may be moved parallel of the packing plate longitudinal direction until the loading head abuts the spring plates 117, 118 of the limit switches.

The loading head 10 is connected to an inclined carrier conveyor 216 of a feed belt conveyor 200. The feed belt conveyor 200 includes a roller track 215 and a feed track 214 that are mounted at the ceiling D of a warehouse or the like (Figure 14). Above the carrier conveyor 216 and parallel thereto is arranged a flattening belt 218. The flattening belt 218 may be spaced from the carrier conveyor 216 by means of springs 217. The overall arrangement is such that the carrier conveyor 216 and the flattening conveyor 218 may follow any height adjustment of the loading head 10 in the direction d_4, and the loading head is movable jointly with the feed belt conveyor 200 in the horizontal direction y, in thus allowing to readily load the unobstructedly accessible loading platform of trucks.

The side walls 231, 233 of the chute 30 may be pivoted about axes 235, 236 by associated actuators 232, 234 (Figure 15), thus allowing the varying of the velocity of the sacks S before the latter engage the packing plate 25. By moving the loading head 10 through a distance of half a sack width in the direction x_3, the sack row SR will be offset with respect to the sack row SR that is stacked underneath (Figure 16).

The embodiment of the loading apparatus shown in Figure 17 includes the loading head 10, and discrete goods such as sacks are fed to this loading head via a feed track. This feed track is formed by a feed conveyor 435, an upwardly and downwardly adjustable storage track 430, a supply conveyor 431 and a pull-off conveyor 432. The loading head 10 includes an alignment conveyor 433 with a sack pivoting assembly 434 by means of which sacks or discrete goods of

other types may be adjusted into a longitudinal or transverse position before being transferred onto the feed conveyor 313 of the loading head 10, in accordance with a predetermined stacking pattern.

In performing the loading operation, the loading head 10 is lowered onto e.g. pallets by means of an elevating mechanism, and then deenergized by means of the lower sensing plate 453 (Figure 18). Subsequently, the loading head 10 is moved towards a ramp or another object until the forward sensing plate 454 comes into engagement with the ramp or other object.

The sacks being discharged from the alignment conveyor 433 pass along a bar chute 455 to the feed conveyor 313 of the loading apparatus 440, and the latter may be vertically adjusted by cross beams 441 actuated by an elevating mechanism (Figure 18). The bar chute 455 comprises bars extending in the feed direction whereby rotational movements of the sacks are prevented so that the sacks are being transferred onto the metering conveyor 413 in the same spatial alignment as has been established on the alignment conveyor 433.

The feed conveyor 313 is followed by a packing table 442 the upper surface of which is formed by a roller track 421 (Figures 18 and 19). The rollers 444 may be driven by a drive unit 443 via a chain drive 445 or the like, and serve to move the sacks against a stop wall 456 arranged at the rear of the packing table 442 when looking in the feed direction. When sacks engage the stop wall 456, the rollers 444 can rotate freely underneath the sacks. The rollers 444 may also consist of centrally divided or split roller halves.

A transfer member 450 may be moved parallel to the longitudinal axis of the rollers 444 via a chain drive 452 and driven by a drive unit 451. The transfer member 450 serves to move a sack row toward one side of the packing table 442. When the last sacks have reached the packing table 442, the transfer member 450 remains in its position. For avoiding gaps being formed between an already deposited sack layer and sacks that are subsequently supplied, there is provided another transfer member 446. This transfer member 446 is driven by a drive unit 447, via a chain drive 448 or the like and may be moved parallel to the longitudinal axis of the rollers 444 to move the entire row of sacks into alignment with a previously deposited row. When removing the packing table 442 whilst the rollers 444 rotate, the stacked sack layer may be transferred. The drive units 447, 451 for the transfer members 446, 450 respectively may be arranged above as well as below the packing table 442.

The packing table surface of the packing table 442 may also consist of a belt conveyor 422 driven by a drive unit 457 and including a smooth low-friction belt 458 (Figures 20 and 21). The conveyor 422 may be dimensioned so as to extend across part or all of the width of the packing table 442.

If the packing table surface includes a roller track 421, the transfer member movable in the longitudinal direction of the rollers may also be formed as a pusher fork 461 (Figure 22). This pusher fork may be moved by means of a control lever 460 that is arranged below the roller track 421 and driven by a chain drive 452 or the like.

Apart from an elevating structure, the loading apparatus furthermore includes control devices for controlling the loading head 10, in order to ensure that the sacks are arranged perfectly intermediate the ramps and are perfectly stacked. Various sack stacking patterns such as may be required for achieving a perfect stability of sack stacks may readily be achieved. The loading head may comprise tolerance compensation devices for adapting the height of the loading head to various elevational levels or level differences of loading platforms.

As a particularly advantageous characteristic, a vertically tiltable chute 431' may be provided at the discharge end portion of the feed conveyor 313. The chute 431 would include support members 432' in sliding or rolling contact with the packing table 442 (Figure 18).

The automatic loading apparatus of the present invention allows the loading platform of trucks (or generally loading platforms of any type or pellets) to be loaded independently of the feeding means, and the latter may consist of a conveyor, a chute or a roller track. The loading apparatus represents a truly multi-purpose equipment that may be employed as a sub-assembly. The loading apparatus may be coupled to the quayside or ship's hold side of ship loading and unloading apparatus, including for example spiral chutes, or may be used in combination with fork lifts and the like. The number of stacked sack layers may vary within very wide limits; as a rule between 5 to 7 sack layers will be stacked. When employing the automatic loading apparatus, no operators are required on the loading platform. The fully automatic operation allows high outputs.

The sack pivoting assembly consists of a rotatably mounted carrier conveyor adapted to be rotated by a drive unit, or a rotary table including devices for transferring the discrete goods onto the feed conveyor.

WHAT WE CLAIM IS:-

1. Apparatus for loading discrete goods onto loading platforms, comprising a support and a loading head depending from and vertically movable in the support, the load-

ing head including:

a rectangular horizontal frame,

a packing table defining a goods-receiving surface and movable in the frame in a first direction between a rest position and a pull-off position,

conveyor means arranged to feed discrete goods one by one to a predetermined point on the packing table in its rest position,

a first stop member mounted on the frame and extending at substantially right angles to said first direction across the whole width of the packing table when the latter is in its rest position,

a pusher member arranged in a vertical plane aligned with said first direction, the pusher member having one end thereof adjacent the goods-receiving surface of the packing table in the rest position of the latter and being drivable in a second direction perpendicular to said first direction to either side alternately through a predetermined distance, and

a second stop member parallel to the first stop member and spaced therefrom, whereby on movement of the packing table from its rest position to its pull-off position goods on the packing table butt against the second stop member to be pulled off the packing table onto a loading surface beneath.

2. Apparatus according to claim 1, in which the packing table comprises a plate.

3. Apparatus according to claim 1, in which the packing table comprises a roller bed.

4. Apparatus according to claim 1, in which the packing table comprises a conveyor belt.

5. Apparatus according to any preceding claim, in which the frame is cantilevered from vertical columns movably received in the support.

6. Apparatus according to any preceding claim, in which the packing table is carried by slides movable on guide rails formed on either side of the frame.

7. Apparatus according to any preceding claim, including a feed conveyor for feeding goods to the loading head.

8. Apparatus according to any preceding claim, in which the conveyor means in the loading head comprises a chute.

9. Apparatus according to any of claims 1 to 7, in which the conveyor means in the loading head comprises a conveyor belt.

10. Apparatus according to any preceding claim, in which a sensing plate is provided on the underside of the frame for controlling downward movement of the loading head.

11. Apparatus according to any preceding claim, in which the loading head is horizontally movable in said first direction.

12. Apparatus according to claim 11, in which the frame is provided with a sensing plate for controlling movement of the loading head in said first direction.

13. Apparatus according to any preceding claim, including feed means for feeding goods to the loading head which feed means includes means for turning sacks to a chosen orientation.

14. Apparatus for loading discrete goods onto loading platforms, substantially as hereinbefore described with reference to and as illustrated in Figures 1, 2 and 5 to 11 or Figures 3, 4 and 5 to 11 or Figures 12 to 16 or Figures 17 to 20 or Figures. 17 to 20 as modified by Figure 21 or Figure 22 of the accompanying drawings.

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Sheet 1

FIG.1

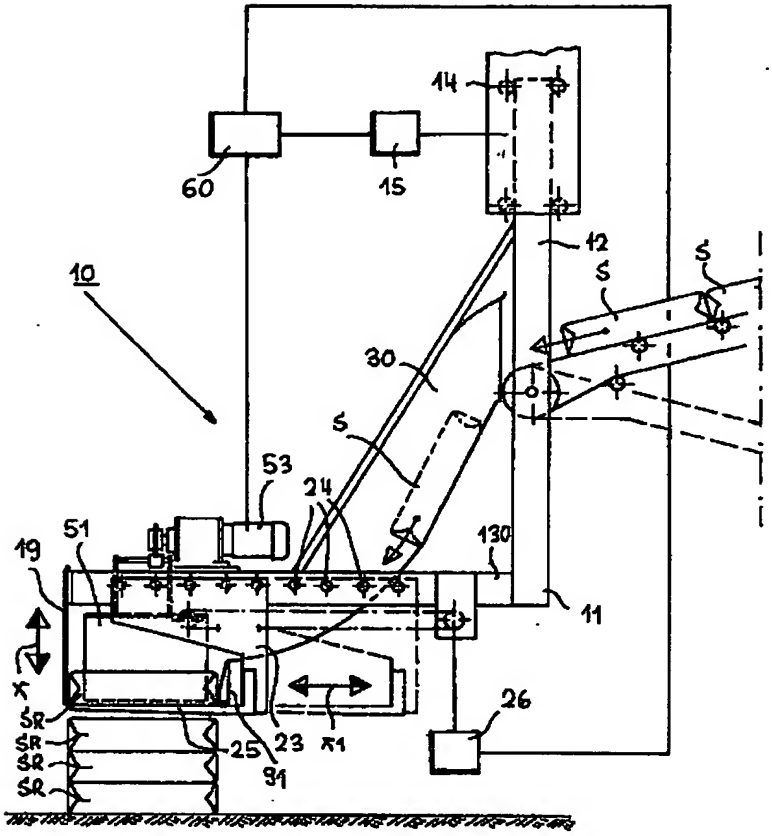

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FIG.2

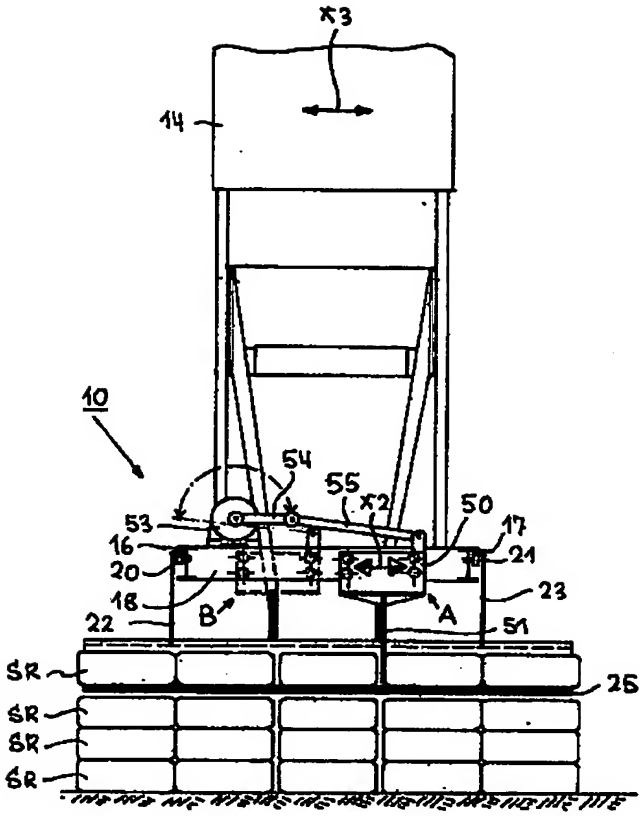

FIG.3

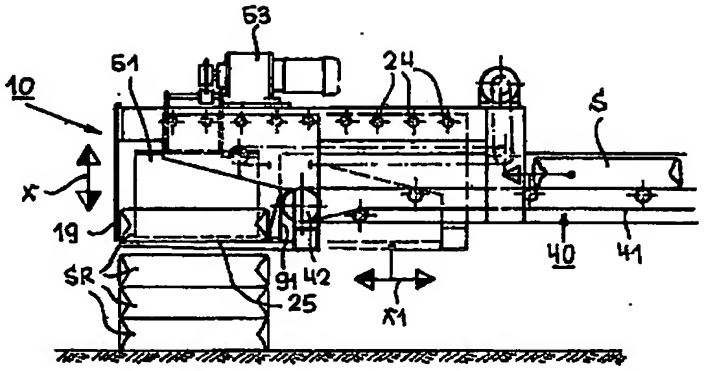

FIG.4

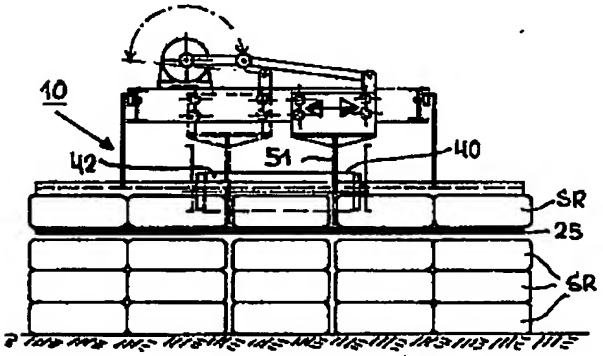

FIG.5

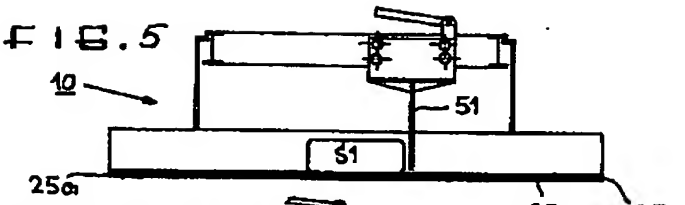

FIG.6

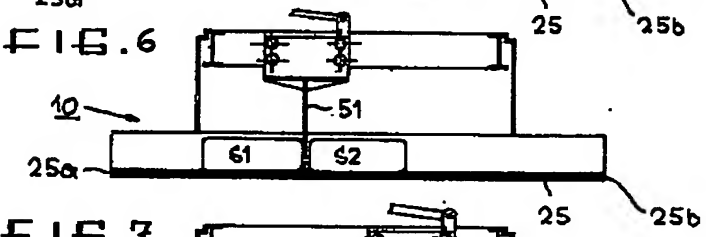

FIG.7

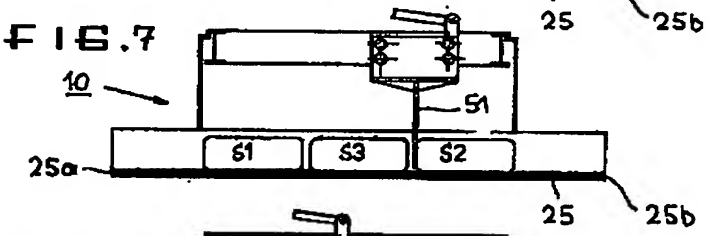

FIG.8

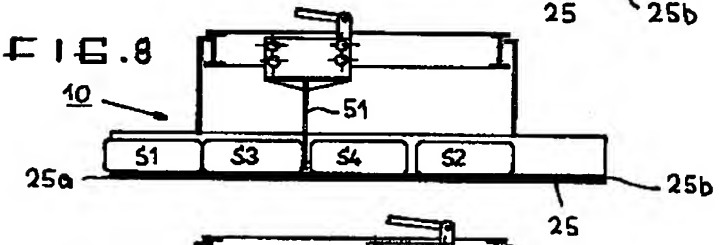

FIG.9

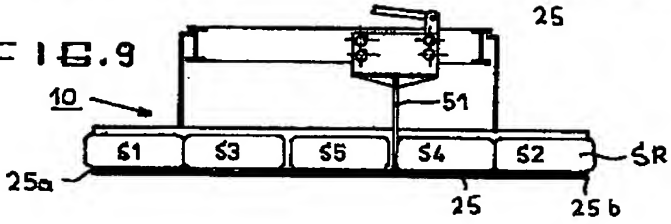

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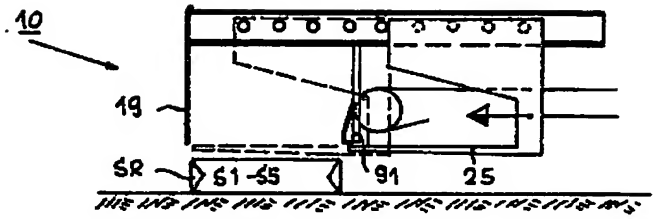
FIG. 11



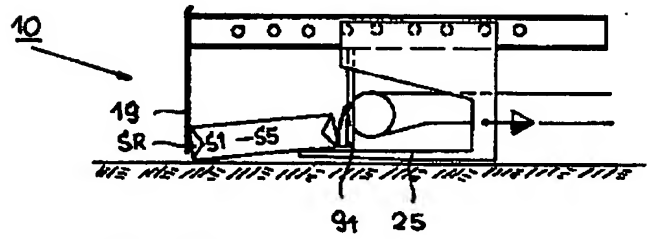


FIG. 10

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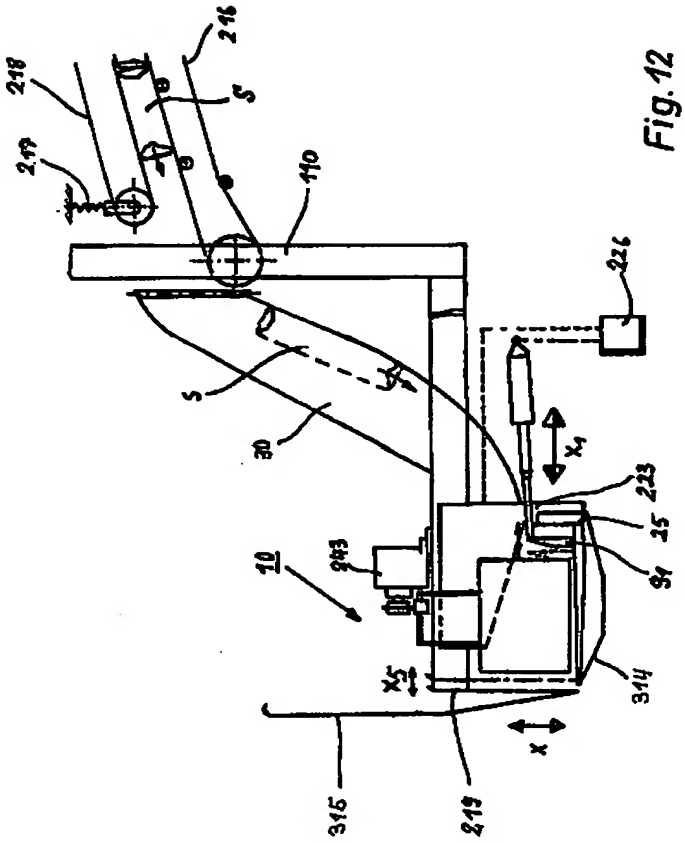

Fig. 12

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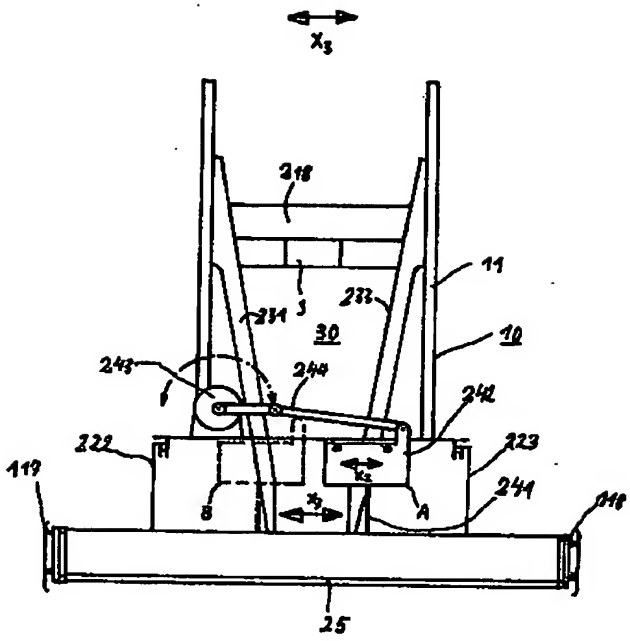

Fig. 13

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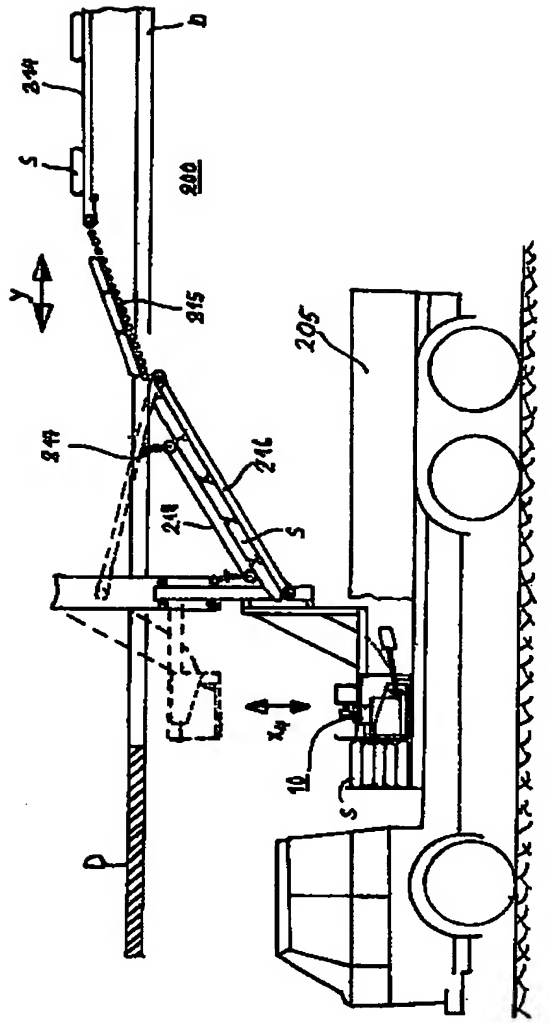

Fig. 14

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13 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 9

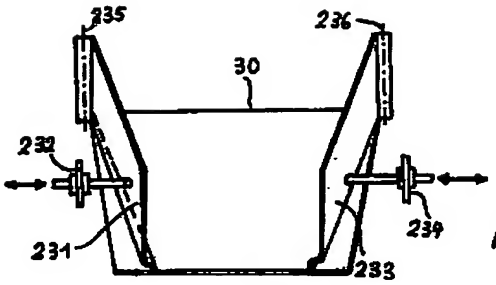
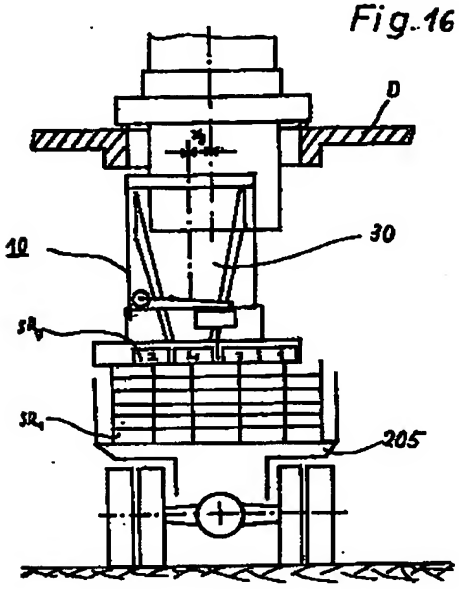


Fig. 15

Fig. 16



1523939 COMPLETE SPECIFICATION
13 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 10

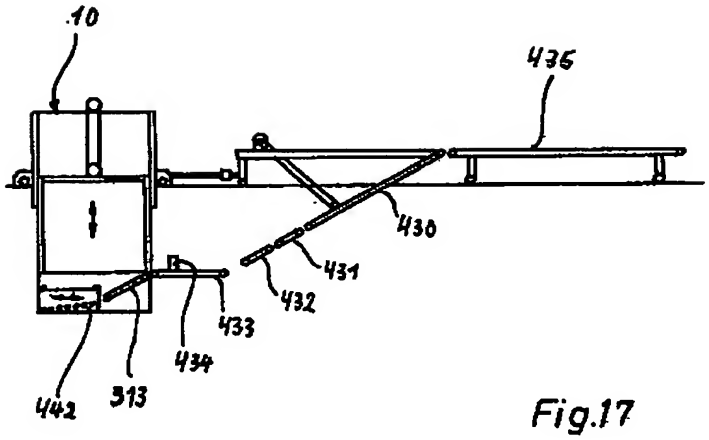


Fig.17

1523939 COMPLETE SPECIFICATION
13 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 11

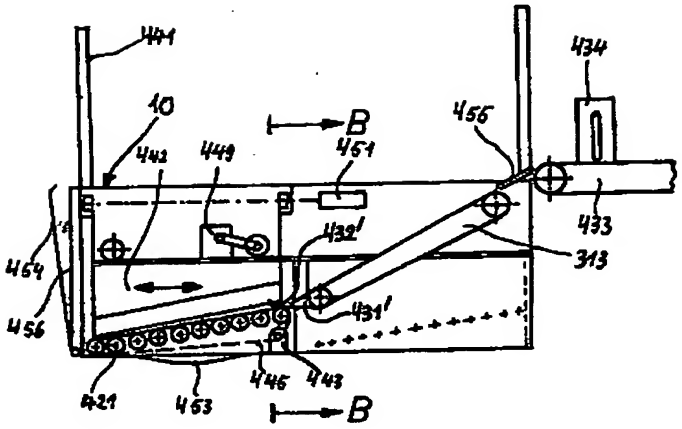


Fig. 18

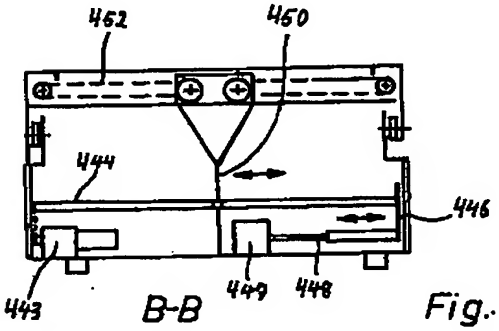
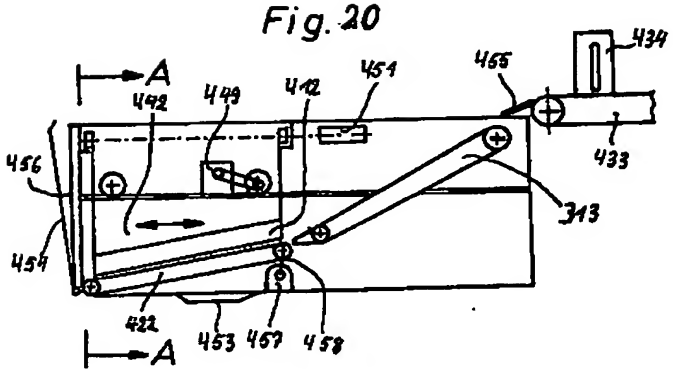


Fig. 19

Fig. 20


A
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442
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465
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433
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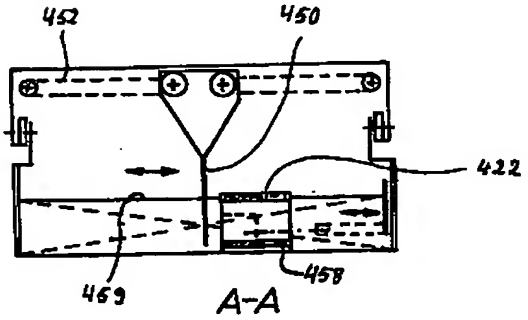
343
454
422
453
457
458
A

Fig. 21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459
458
A-A

1523939 COMPLETE SPECIFICATION
13 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 13

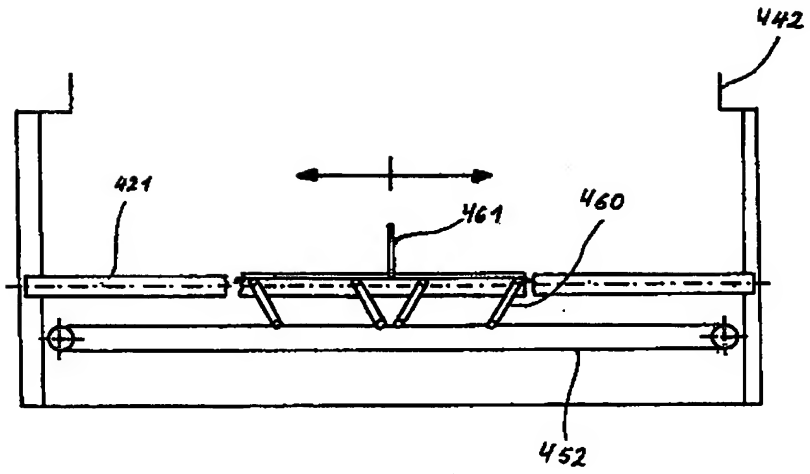

Fig. 22